Nematology Circular No. 57
November 1979

Fla. Dept. Agric. & Consumer Services
Division of Plant Industry

THE RICE ROOT NEMATODE, HIRSCHMANNIELLA ORYZAE

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Fig. 1. Rice seedlings infected with rice root nematodes.

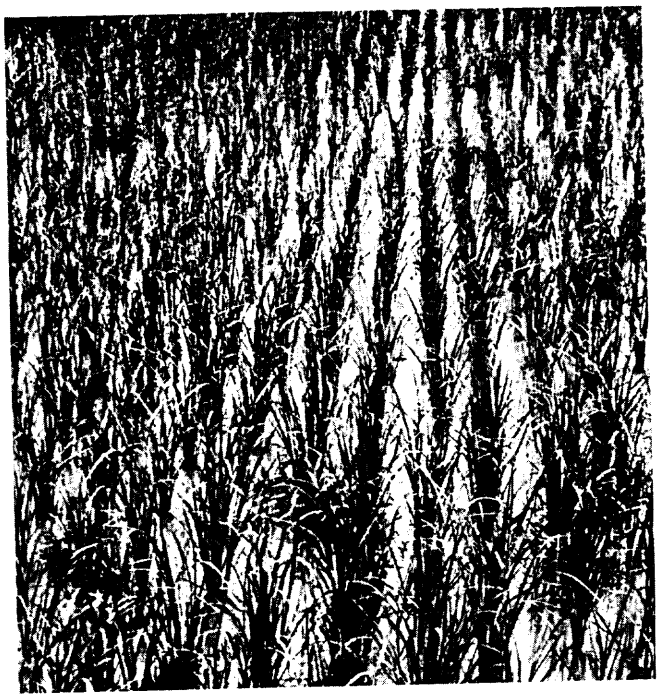

Fig. 2. Rice seedlings, same age, after pre-plant nematicidal treatments of seedlings and paddy.

(Photographs furnished by A. L. Taylor)

The rice root nematodes are capable of reducing rice yield by 24-56 percent, and are among the most common nematode species parasitizing rice throughout the world (2,6,7,12). There are presently 18 species within the genus Hirschmanniella (8,9). At one time, 7 distinct species which parasitized the roots of rice were considered to be the single species H. oryzae (1,2). In 1968, S. A. Sher published a revision of the genus Hirschmanniella and separated the closely related species of rice root nematodes (8). Some references to this nematode made earlier than 1968 may include a number of different species which have been treated as a single species.

Hirschmanniella oryzae (Soltwedel, 1889) Luc & Goodey, 1963 is probably the most widely known species of the rice root nematodes (8,10,12). It has been reported in Brazil, Ceylon, Egypt, El Salvador, France, Ghana, India, Indonesia, Japan, Malagasy Republic, Malaysia, Nigeria, Philippines, Sierra Leone, Thailand, Taiwan, United States, and Venezuela (3,6,9,11).

Although rice is the principal host, about 30 other plants are reported to be parasitized by H. oryzae including cotton, corn, and sugarcane (4,9,11,12). Since H. oryzae is frequently found co-existing with one or more closely related species, it is possible that some of the host data originating prior to 1968 may contain some degree of inaccuracy (8,9).

Symptoms and Pathology: Generally, there are no recognizable field symptoms accompanying a natural infection of Hirschmanniella spp. in full-grown rice. Rice has a very homogeneous appearance, and experimentally demonstrated reductions of growth and yield are usually not perceived during visual observation of an average rice crop (6,10).

Experimental results have shown that symptoms may appear 4 weeks after infection. Growth was stopped, number of tillers (suckers) reduced, and flowering was delayed 12-14 days (6). Infected seedlings showed reduced numbers, delayed emergence of tillers, and discolored older leaves (9). Since paddies in a given area have a tendency to look alike, the seedling-stage field symptoms shown in this circular might not be noticed without a nematode-free plot for comparison in the same area. Many inoculated plants showed what appeared to be complete recovery after initial retardation of growth (6,9). It is believed that plant recovery is due to the rapid rate of root regeneration which exceeds the rate of multiplication and spread of the nematodes (9). Consequently, an infested field may show no symptoms other than reduced grain yields (10).

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Hirschmanniella oryzae may attack rice roots at any point except the tips or the thin lateral roots (10). Males and females may enter roots through openings caused by other nematodes (2). Inside the root, they move freely through air channels existing between the radial lamellae of the parenchyma tissue (6,9). Some nematodes enter the root completely, others embed only their heads (5). They have been observed feeding from vascular bundles, and may be found feeding on cortical cells anywhere inside the root from the base to the tip (5). They feed mostly on the cells at the bases of the root hairs, killing these cells and root hairs (2,10).

Small brown lesions appear on the roots at points where nematodes have ruptured the surface and entered (6,10). Damaged epidermal cells become necrotic (9,10). Cavities form inside the roots as a result of damage to cortical cells (6,9). Infected roots first show a yellowish to brown color which darkens (2,10). Heavily infected roots decay after turning brown or black (10).

Life Cycle and Biology: One month is required for development of an adult from the egg (2). Several days after the female nematode enters the root, eggs are laid (2). The eggs, laid mostly in the cortex, hatch after 4 to 5 days while inside the root (5,6). Freshly laid eggs, oval in shape, measure 66-72 microns long by 26-40 microns wide (5). Larvae pass through 4 moults, the first of which is inside the egg (5,11). After the 4th moult, immature adult males and females emerge with gonads not yet fully developed (11). Rice root nematodes are reported to increase as much as 15-fold in 130 days (9).

Survival: Nematodes may leave the dead roots and inhabit the soil around infected plants. They survive between crops in the roots of paddy field weeds and self-sown rice plants (9,10). Eggs are usually the overwintering stage, although both eggs and larvae will overwinter in dead roots (9). Rice root nematodes have demonstrated a 12% survival rate after one year in the absence of a host (7). When a rice paddy dries, the nematodes can survive in a state of anhydrobiosis until the rains begin (10). They have survived 8 months in dry soil which was stored indoors (4,11). They have survived in water suspensions up to 4 months (4).

Control: Nematicides are not the most satisfactory answer for control of rice root nematodes around the world (2). Rice does not have a high enough cash value in developing countries for nematicides to be economically feasible. Nutritional experiments indicate that plants given proper cultural care can produce a satisfactory crop though heavily infected (6,9,11). Dry fallow and rotation reduce the nematode population, but many farmers cannot afford taking land out of production the necessary length of time (7,9). Weed control has been effective in reducing nematode numbers. In Japan, rice is considered to be universally infected with rice root nematodes (2). Since rice grows well and responds to fertilizer, a degree of natural selection and resistance appears to exist (2). Investigations of varietal resistance are in progress in some countries.

Survey and Detection:

1) No recognizable field symptoms can be seen on the top parts of rice plants. Examine individual plants for roots which are discolored, darkened, or decayed.
2) Submit roots, packaged with some accompanying damp soil, to a nematology laboratory.

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